CLEAR FIELD ANNULAR TYPE PHASE SHIFTING MASK

FIELD OF THE INVENTION

[0001] The present invention relates to integrated circuit fabrication and more particularly to a phase shifting mask used in a photolithography process and a method of manufacturing therefor.

DESCRIPTION OF RELATED ART

[0002] In the semiconductor industry, there is a continuing effort to increase device density by scaling the device size. Conventionally, to form an integrated circuit, a resist layer is formed on a wafer and is exposed to radiation through a photomask ("mask"). A mask typically comprises a substantially transparent base material such as quartz with an opaque layer having a desired pattern formed thereon. For example, chrome has long been used to make the opaque layer. When device features are reduced to a dimension below 1 micron, diffraction effects become significant. The blending of two diffraction patterns associated with features which are close to each other has an adverse effect on resolution, because portions of the resist layer underlying the opaque layer near the edges of features will be exposed.

[0003] To minimize effects of diffraction, various kind of phase shifting masks have been used. Typically, a phase shifting mask has a pattern in the opaque layer, corresponding to the pattern to be formed on the underlying resist. In addition, phase-shifters, which transmit the incident radiation and shift the phase of the radiation approximately 180 degrees, are added onto the mask reduce diffraction effects. Alternate aperture phase shifting masks are formed by adding phase-shifters over every other opening. In rim phase shifting masks, phase-shifters are added along or near the outer edges of features. The radiation transmitted through the phase-shifter destructively interferes with radiation transmitted through the feature, thereby reducing the intensity of radiation incident on the resist material underlying the opaque layer near a feature edge to in order to improve image resolution.

[0004] Such phase shifting masks, however, have limitations on their ability to pattern some features and are difficult to fabricate. When two features are placed in close proximity to one another, for example, in rim phase shifting masks, two phase-shifters associated with features which are close to each other would roughly merge into a wide rim resulting in over exposure of the region of resist material between two openings. Further, phase-shifters may be